(12) UK Patent Application (19) GB (11) 2 339 645 (13) A

(43) Date of A Publication 02.02.2000

(21) Application No 9815204.4

(22) Date of Filing 14.07.1998

(51) INT CL[7]
H04Q 7/22

(52) UK CL (Edition R)
H4L LDGP L1H10

(56) Documents Cited
EP 0615393 A1 WO 97/48249 A1 WO 97/20444 A1

(58) Field of Search
UK CL (Edition P) H4L LDGP
INT CL[6] H04Q 7/22
ONLINE: WPI

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(54) Abstract Title
Communication System Providing a Packet Data Service

(57) A radio link between a mobile communications unit and a base station comprises in addition to the usual forward and reverse traffic channels and associated access and control channels a reverse packet traffic channel and, in the downlink, a forward packet data channel and a packet control channel. The packet data is intermittent, and the packet data channel is occupied, under the control of the packet control channel, only during a data transmission (packet busy state), and is released when the system enters a packet idle state.

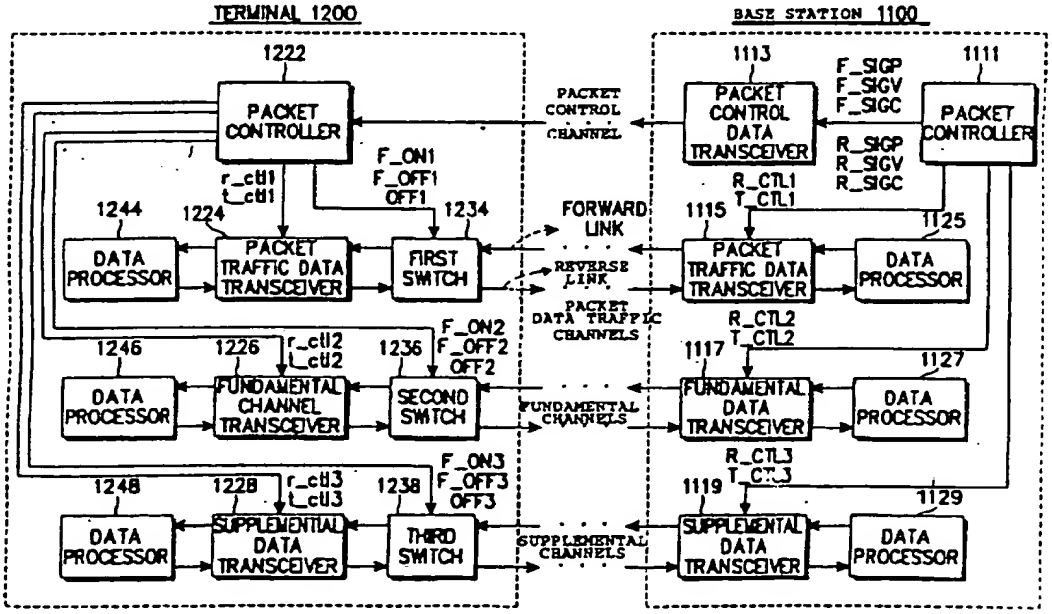

FIG. 11

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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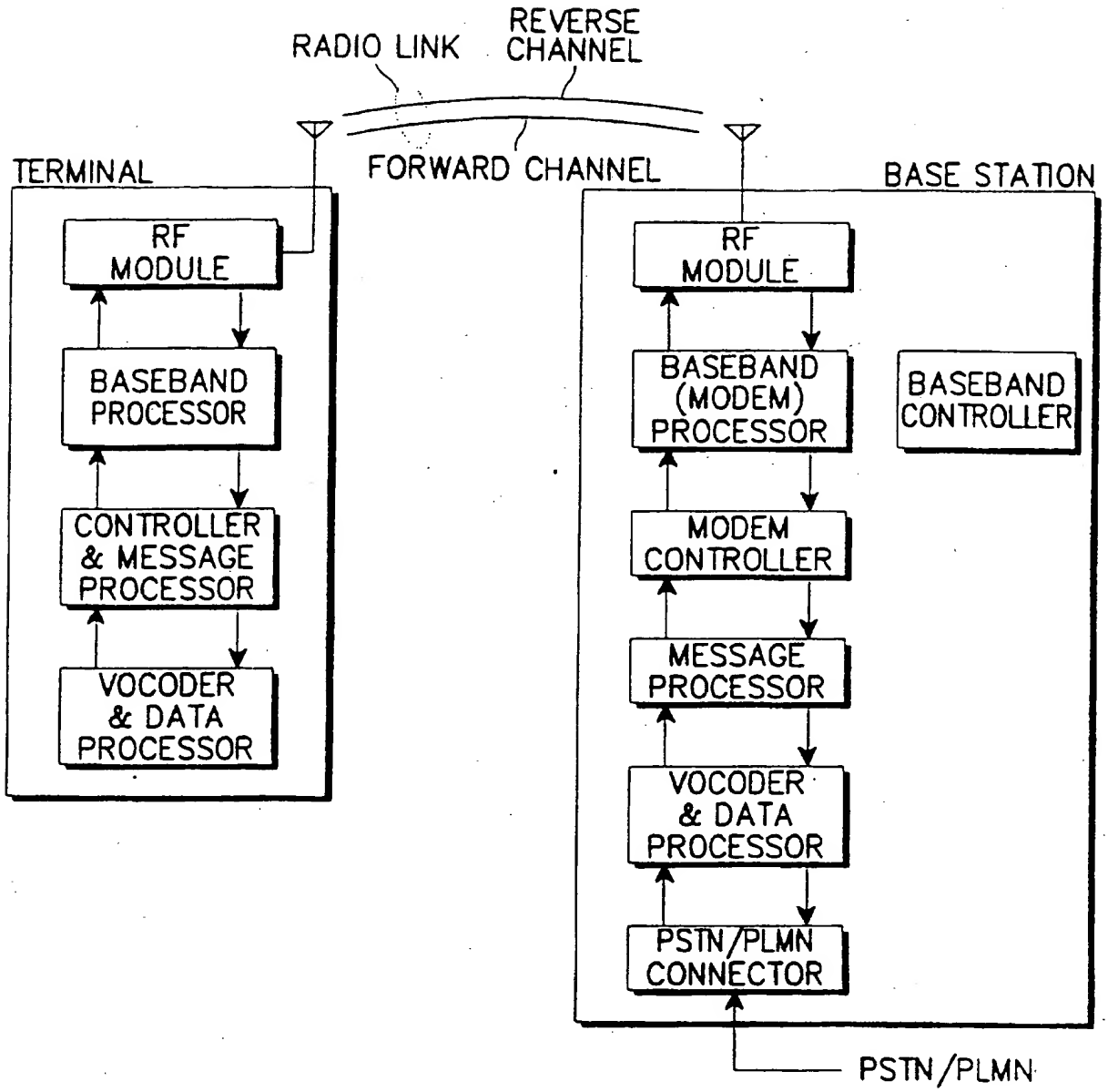
RADIO LINK
REVERSE CHANNEL
FORWARD CHANNEL
TERMINAL
RF MODULE
BASEBAND PROCESSOR
CONTROLLER & MESSAGE PROCESSOR
VOCODER & DATA PROCESSOR
BASE STATION
RF MODULE
BASEBAND (MODEM) PROCESSOR
BASEBAND CONTROLLER
MODEM CONTROLLER
MESSAGE PROCESSOR
VOCODER & DATA PROCESSOR
PSTN/PLMN CONNECTOR
PSTN/PLMN

FIG. 1

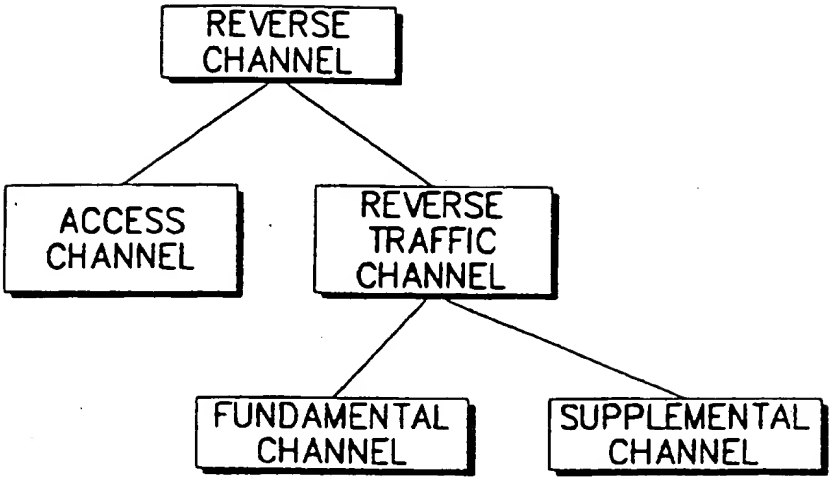
REVERSE CHANNEL
ACCESS CHANNEL
REVERSE TRAFFIC CHANNEL
FUNDAMENTAL CHANNEL
SUPPLEMENTAL CHANNEL

FIG. 2

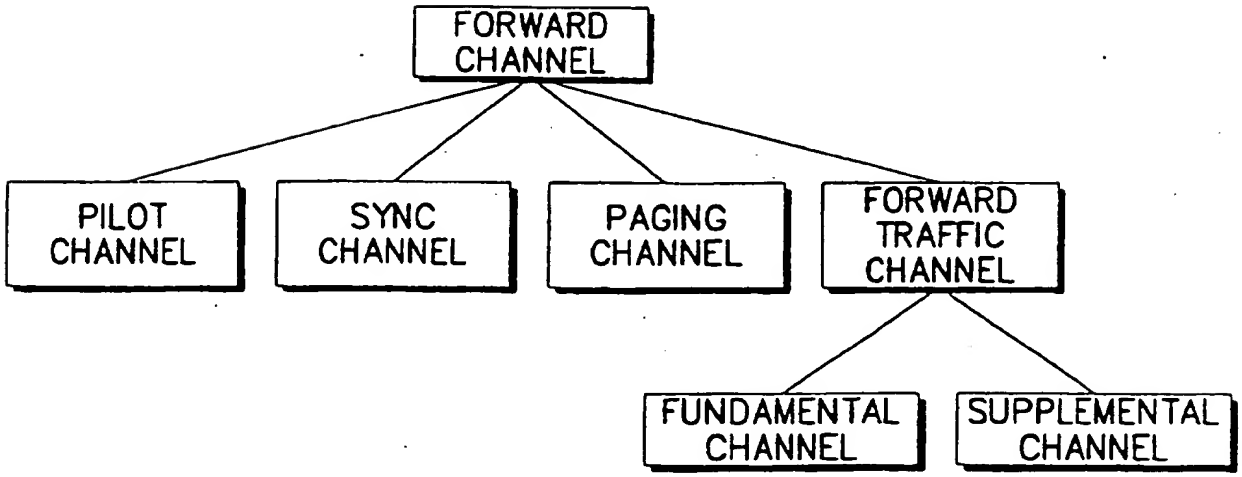
FORWARD CHANNEL
PILOT CHANNEL
SYNC CHANNEL
PAGING CHANNEL
FORWARD TRAFFIC CHANNEL
FUNDAMENTAL CHANNEL
SUPPLEMENTAL CHANNEL

FIG. 3

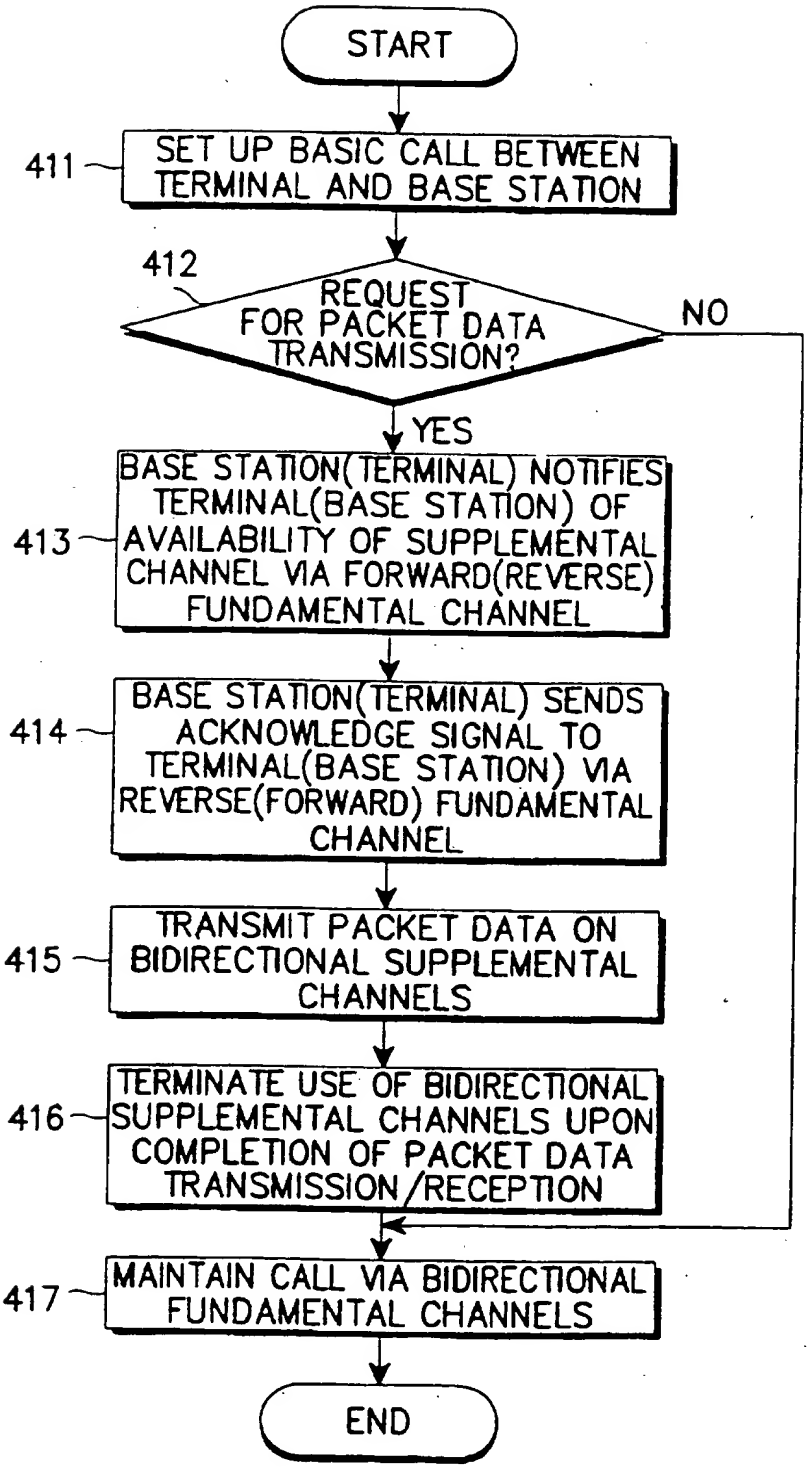
START
411
SET UP BASIC CALL BETWEEN TERMINAL AND BASE STATION
412
REQUEST FOR PACKET DATA TRANSMISSION?
NO
YES
413
BASE STATION(TERMINAL) NOTIFIES TERMINAL(BASE STATION) OF AVAILABILITY OF SUPPLEMENTAL CHANNEL VIA FORWARD(REVERSE) FUNDAMENTAL CHANNEL
414
BASE STATION(TERMINAL) SENDS ACKNOWLEDGE SIGNAL TO TERMINAL(BASE STATION) VIA REVERSE(FORWARD) FUNDAMENTAL CHANNEL
415
TRANSMIT PACKET DATA ON BIDIRECTIONAL SUPPLEMENTAL CHANNELS
416
TERMINATE USE OF BIDIRECTIONAL SUPPLEMENTAL CHANNELS UPON COMPLETION OF PACKET DATA TRANSMISSION/RECEPTION
417
MAINTAIN CALL VIA BIDIRECTIONAL FUNDAMENTAL CHANNELS
END

FIG. 4

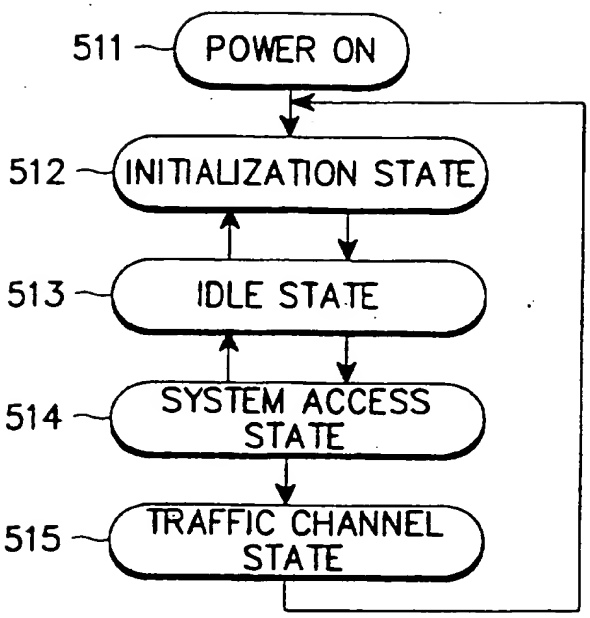
511
POWER ON
512
INITIALIZATION STATE
513
IDLE STATE
514
SYSTEM ACCESS STATE
515
TRAFFIC CHANNEL STATE

FIG. 5

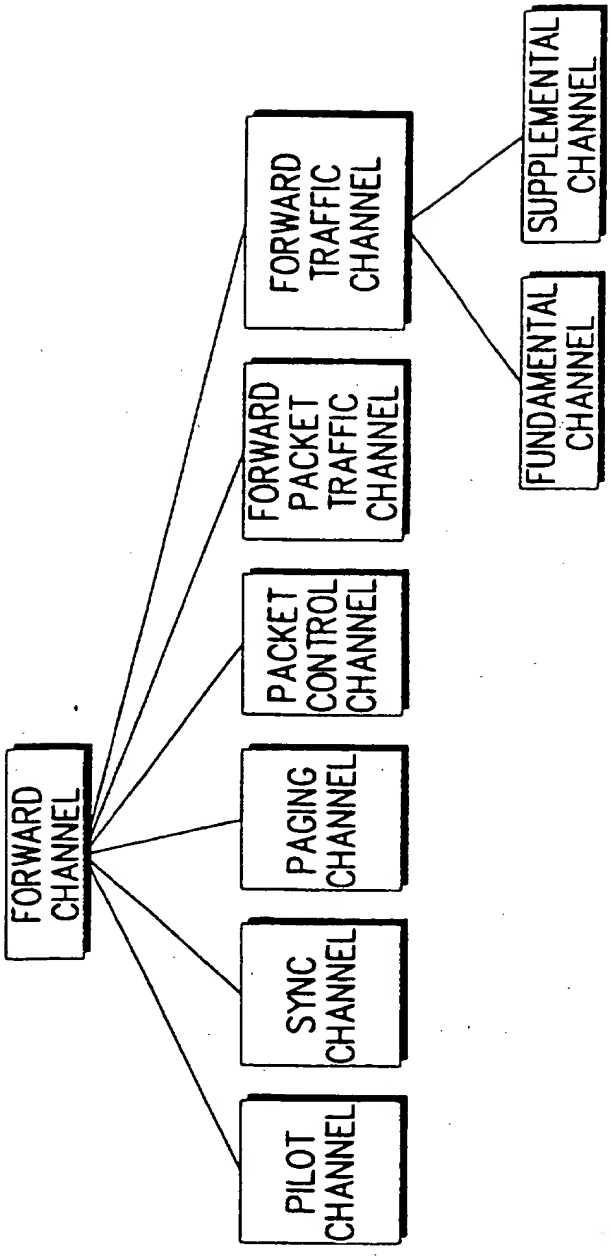
FORWARD CHANNEL
PILOT CHANNEL
SYNC CHANNEL
PAGING CHANNEL
PACKET CONTROL CHANNEL
FORWARD PACKET TRAFFIC CHANNEL
FORWARD TRAFFIC CHANNEL
FUNDAMENTAL CHANNEL
SUPPLEMENTAL CHANNEL

FIG. 6

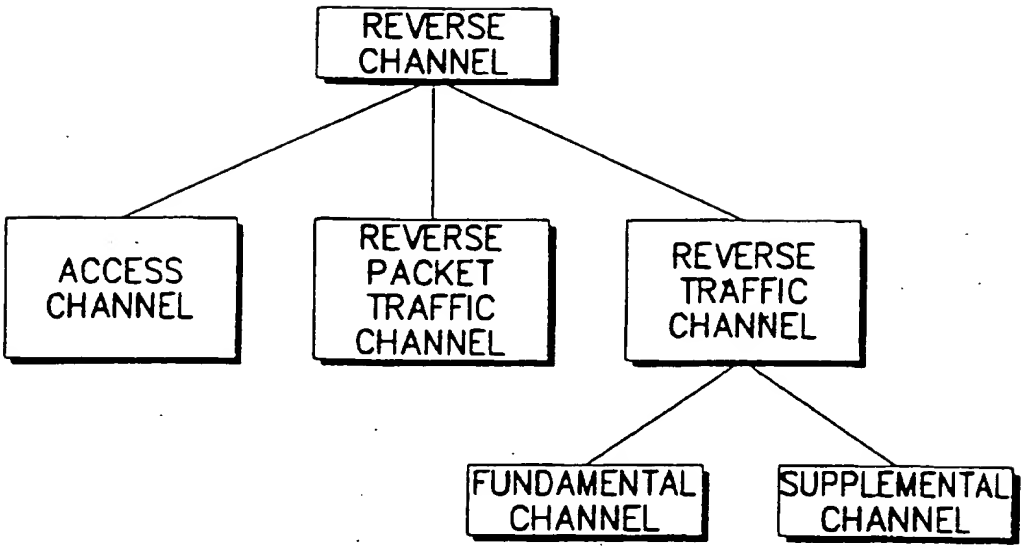
REVERSE CHANNEL
ACCESS CHANNEL
REVERSE PACKET TRAFFIC CHANNEL
REVERSE TRAFFIC CHANNEL
FUNDAMENTAL CHANNEL
SUPPLEMENTAL CHANNEL

FIG. 7

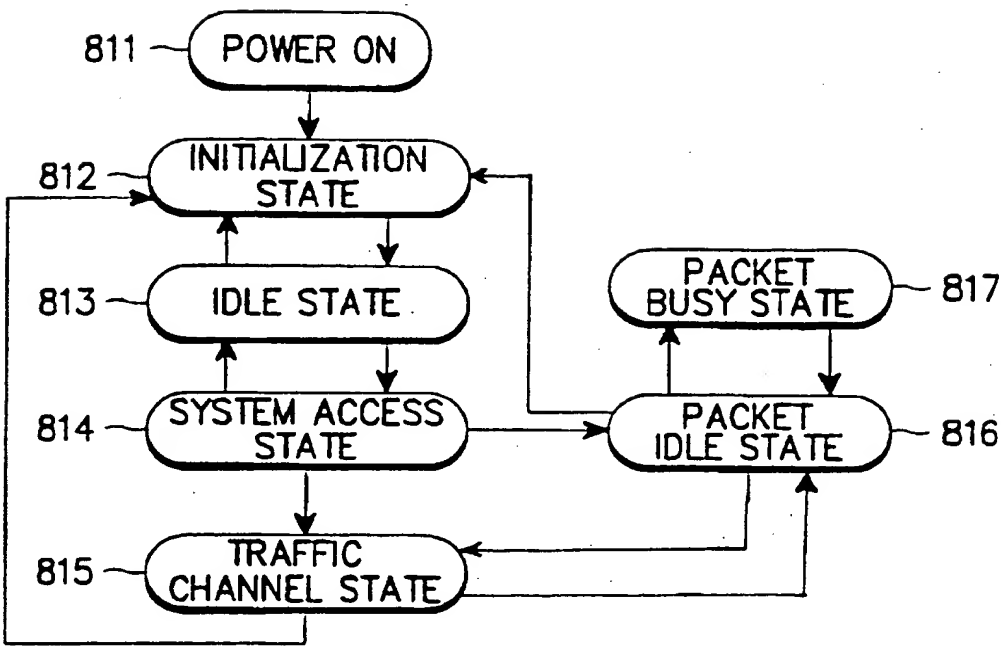
811
POWER ON
812
INITIALIZATION STATE
813
IDLE STATE
814
SYSTEM ACCESS STATE
815
TRAFFIC CHANNEL STATE
PACKET BUSY STATE
817
PACKET IDLE STATE
816

FIG. 8

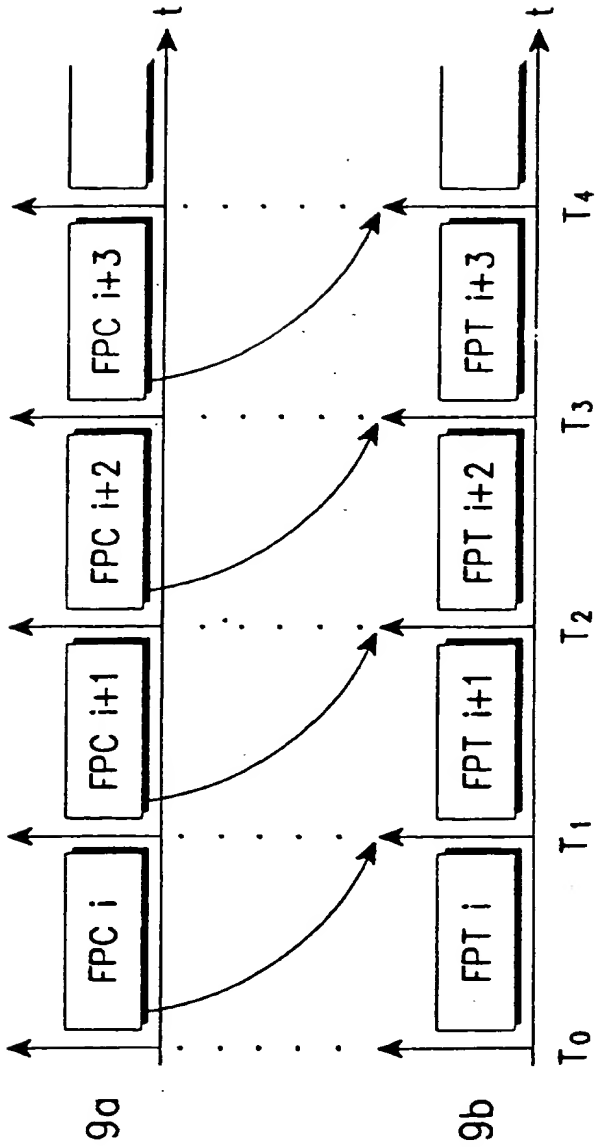
t
FPC i
FPC i+1
FPC i+2
FPC i+3
FPT i
FPT i+1
FPT i+2
FPT i+3
T0
T1
T2
T3
T4
9a
9b

FIG. 9

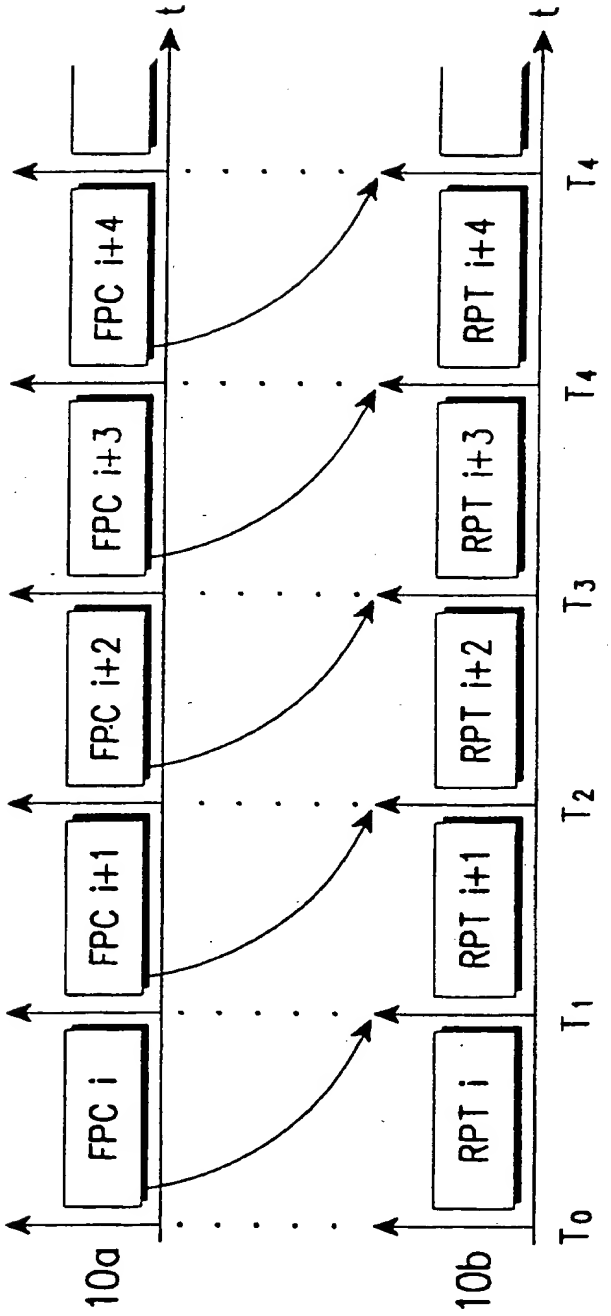
10a
10b
FPC i
FPC i+1
FPC i+2
FPC i+3
FPC i+4
RPT i
RPT i+1
RPT i+2
RPT i+3
RPT i+4
t
t
T0
T1
T2
T3
T4
T4

FIG. 10

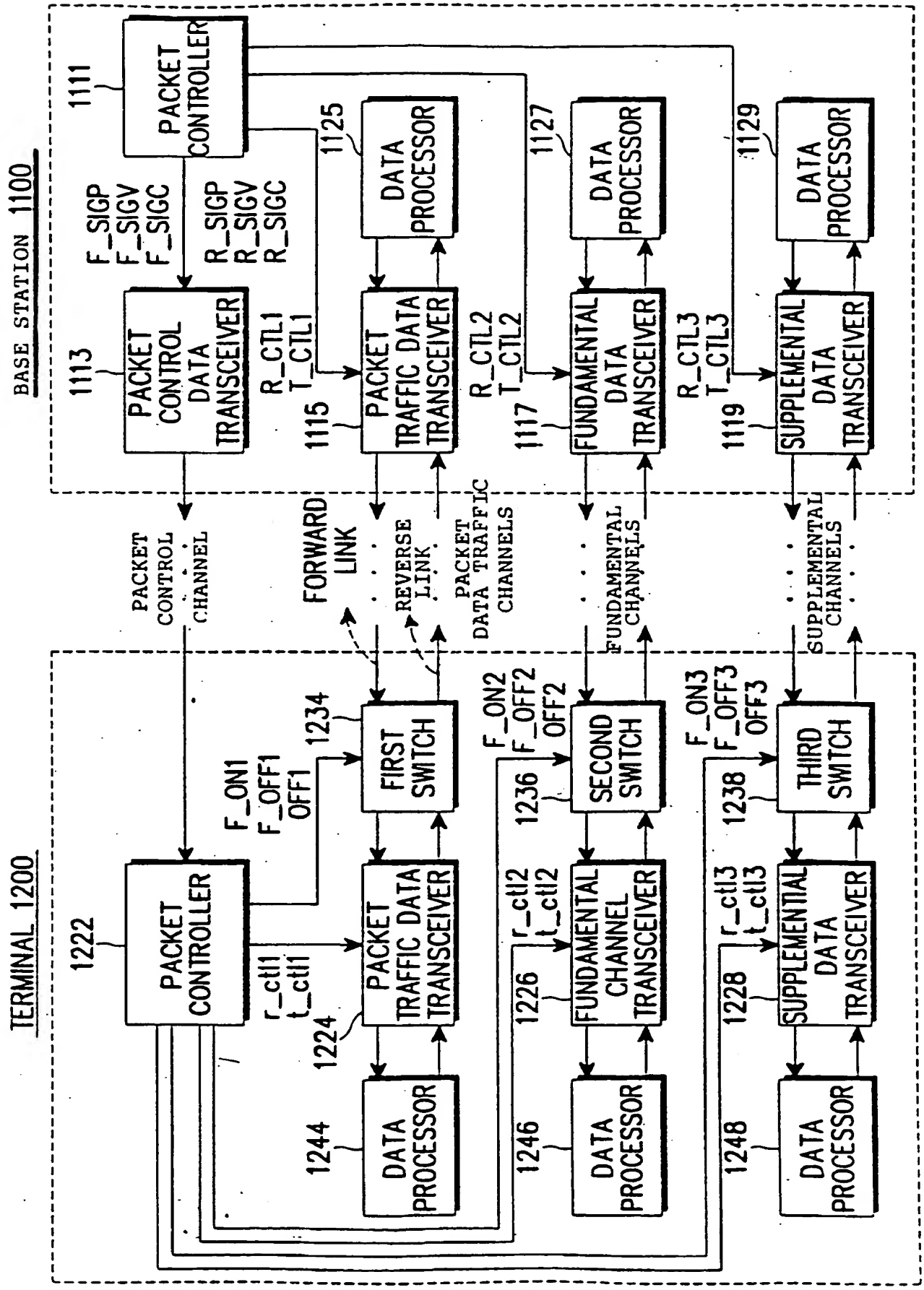
BASE STATION 1100
PACKET CONTROLLER
1111
PACKET CONTROL DATA TRANSCEIVER
1113
PACKET TRAFFIC DATA TRANSCEIVER
1115
FUNDAMENTAL DATA TRANSCEIVER
1117
SUPPLEMENTAL DATA TRANSCEIVER
1119
DATA PROCESSOR
1125
DATA PROCESSOR
1127
DATA PROCESSOR
1129
F_SIGP
F_SIGV
F_SIGC
R_SIGP
R_SIGV
R_SIGC
R_CTL1
T_CTL1
R_CTL2
T_CTL2
R_CTL3
T_CTL3
PACKET CONTROL CHANNEL
FORWARD LINK
REVERSE LINK
PACKET DATA TRAFFIC CHANNELS
FUNDAMENTAL CHANNELS
SUPPLEMENTAL CHANNELS
TERMINAL 1200
PACKET CONTROLLER
1222
PACKET TRAFFIC DATA TRANSCEIVER
1224
FUNDAMENTAL CHANNEL TRANSCEIVER
1226
SUPPLEMENTAL DATA TRANSCEIVER
1228
DATA PROCESSOR
1244
DATA PROCESSOR
1246
DATA PROCESSOR
1248
FIRST SWITCH
1234
SECOND SWITCH
1236
THIRD SWITCH
1238
F_ON1
F_OFF1
OFF1
F_ON2
F_OFF2
OFF2
F_ON3
F_OFF3
OFF3
r_ctl1
t_ctl1
r_ctl2
t_ctl2
r_ctl3
t_ctl3

FIG. 11

A COMMUNICATION SYSTEM PROVIDING A PACKET DATA SERVICE

Background of the Invention

The present invention relates to a data communication method in a CDMA (Code Division Multiple Access) communication system, and in particular, to a method for providing a packet data service.

In CDMA currently used in communication systems, and W-CDMA (Wideband-CDMA) considered as a standard for the next generation of communication systems, packet data communication is implemented using a one-to-one continuous connection established between a terminal and a base station. A packet data service in a conventional CDMA communication system suffers from excessive overheads due to the continuous one-to-one connection state of communication channels during a packet data service. The efficiency of use of channel capacity is low, and user cost is high.

Demand for data communication services such as PC (Personal Computer) communication, Internet access and mobile-communication based data services are increasing. Most data services are performed in the form of packet data and data transmission in such services is intermittent, rather than continuous. However, since the conventional CDMA communication system continuously connects a communication channel between a terminal and a base station, this channel is idle between intermittent transmissions of packet data.

Accordingly, there is an ever increasing need to enable more subscribers to inexpensively access data services. This should preferably be achieved while subjecting an

interface structure in the conventional CDMA network to a minimum of modification.

FIG. 1 is a block diagram of a terminal, a base station, and a radio link in a mobile communication system. The radio link of FIG. 1 is composed of a forward channel for data transmission from the base station to the terminal and a reverse channel for data transmission from the terminal to the base station.

A conventional CDMA mobile communication system has a forward channel structure as shown in FIG. 3. The forward CDMA channel has a pilot channel, a sync channel, a paging channel, and a forward traffic channel divided into a fundamental channel and a supplemental channel.

Typically, a conventional CDMA mobile communications system also has a reverse channel structure as shown in FIG. 2. The reverse CDMA channel includes an access channel and a reverse traffic channel divided into a fundamental channel and a supplemental channel.

A conventional bi-directional traffic channel has too low a bit rate to provide a packet data service. A conventional approach to ensuring a bit rate high enough for the packet data service in a conventional bi-directional traffic channel is to separate it into a fundamental channel for providing the function of the conventional bi-directional traffic channel, and a supplemental channel for use in packet data communication.

For a packet data service, a call should be maintained between a base station and a terminal as shown in FIG. 1 via forward and reverse fundamental channels. FIG. 4 is a flowchart showing the use of channels in a conventional packet data service.

In the following description, bi-directional data transmission will be discussed. Such data transmission is largely symmetrical, and for brevity will be discussed in respect of one data transmission direction, with terminology relating to the other data transmission direction appearing in parentheses.

Referring to FIG. 4, in step 411, a basic call is set up between a terminal and a base station using a pilot channel, a sync channel, a paging channel and an access channel. Here, the basic call is bi-directionally performed on forward and reverse fundamental channels. In step 412, the base station (terminal) determines whether a request for packet data transmission has been issued from the terminal (base station). In the absence of a packet data transmission request, the procedure jumps to step 417 in which the call is maintained on the bi-directional fundamental channels only.

If a packet data transmission request is detected in step 412, the base station (terminal) notifies the terminal (base station) of use of a supplemental channel with the forward (reverse) fundamental channel, in step 413. The terminal (base station) sends an acknowledge signal to the base station (terminal) on the reverse (forward) fundamental channel, in step 414. In step 415, packet data is transmitted often intermittently, on bi-directional supplemental channels. Upon completion of the packet data transmission/reception, the bi-directional supplemental channels stop their action in step 416. Then, the call is maintained on the bi-directional fundamental channels, in step 417.

The above call set-up procedure will be reviewed with respect to the terminal. A controller of the terminal obtains information on a corresponding base station via a

pilot channel, a sync channel, and a paging channel among the forward channels of the base station. Information for access to the base station is generated by a message processor of the terminal, converted to a signal by a baseband processor, and transmitted to the base station on a reverse access channel.

A message processor in the base station analyses the access information received from the terminal, gets forward and reverse fundamental channels ready, and sends to the terminal a message on the paging channel indicating that the fundamental channels are ready. The message processor of the terminal connects to the forward fundamental channel, using the bi-directional fundamental channel information received from the base station. Then, the terminal sends a signal to the base station on the reverse fundamental channel in order to allow the base station to connect to the reverse fundamental channel. When the base station succeeds in connecting to the reverse fundamental channel, it notifies the terminal of the fact on the forward fundamental channel. When the base station and the terminal obtain the bi-directional fundamental channels, the call set-up is completed.

Following the call set-up on the bi-directional fundamental channels, the terminal and the base station await packet data transmission/reception request, while exchanging their information on the bi-directional fundamental channels. In the absence of transmit/receive packet data, the call should be maintained on the bi-directional fundamental channels (step 417). Packet data communication after the call set-up is implemented while repeating the procedure shown in FIG. 4.

FIG. 5 is a state transition diagram of a terminal using a conventional CDMA standard. Referring to FIG. 5, when

power is turned on in a state 511, the terminal is set to an initialisation state 512. If the terminal synchronises its timing to that of a system in the initialisation state 512, it transits to an idle state 513. If the terminal attempts a call, the base station transmits information of the call attempt to the terminal on a paging channel, and the terminal sends a page response message to the base station, in the idle state 513. Then, the terminal is set to a system access state 514. If the terminal fails to obtain a paging channel message or is directed from the base station to a different adjacent base station in a handoff in the idle state 513, the terminal returns to the initialisation state 512. If the terminal succeeds in system access except for the call attempt or reception of a call acknowledge signal in the system access state 514, the terminal returns to the idle state 513. On the contrary, if the terminal succeeds in the call attempt or reception of the call acknowledge signal in the system access state 514, it goes to a traffic channel state 515. The traffic channel state 515 lasts as long as traffic is processed. When traffic channels stop their action, the call is over, and the terminal returns to the initialisation state 512.

In the conventional packet data service, a communication system should maintain a call on bi-directional supplemental channels despite infrequent transmit/receive packets. For example, assuming that packet data is transmitted/received for about one second per minute, the communication system remains logged on the bi-directional supplemental channels for repeated periods of 59 seconds even with data transmission/reception suspended. This represents wasted time, which would more usefully be used in providing other communications services. In this case, a signal transmitted on the bi-directional supplemental

channels interferes with another channel, resulting in wasted capacity of another supportable service in the CDMA communication network. Furthermore, as more users demand the packet data service, the CDMA mobile communication network becomes less accessible to users confined to voice communication on fundamental channels only.

The constraint of continuous connection between the terminal and the base station for intermittent transmission/reception of short packet data increases packet data communication cost and places on obstacle on wide provision of packet data communication over the CDMA mobile communication network. As a result, the CDMA mobile communication lags behind other communication systems in competitiveness and will be less provided.

Summary of the Invention

According to the present invention, there is provided a method for providing a packet data communication service between a terminal and a base station in a mobile communication system, comprising the steps of occupying a reverse channel during a data transmission period; transmitting packet data from the terminal to the base station on the occupied reverse channel during the data transmission period; and releasing the occupation of the reverse terminal during a data transmission suspended period.

The present invention also provides a method for providing a packet data communication service between a terminal and a base station in a mobile communication system, comprising the steps of occupying a forward channel during a data transmission period; transmitting

packet data from the base station to the terminal on the forward channel during a data transmission period; and releasing the occupation of the forward terminal during a data transmission suspended period.

The present invention also provides a terminal comprising means for occupying a reverse channel during a data transmission period; means for transmitting packet data from the terminal to the base station on the occupied reverse channel during the data transmission period; and means for releasing the occupation of the reverse channel during a data transmission suspended period.

The present invention also provides a base station comprising means for occupying a forward channel during a data transmission period; means for transmitting packet data from the base station to the terminal on the forward channel during a data transmission period; and means for releasing the occupation of the forward channel during a data transmission suspended period.

Preferably, control signals are transmitted over a packet control channel from the base station to the terminal to control occupancy of forward and reverse channels.

Preferably, the forward and reverse channels each comprise a fundamental channel, a supplemental channel and a packet data traffic channel.

Preferably, providing a packet data communication service includes the steps of transmitting a control signal over a packet control channel to indicate that packet data is to be transmitted; enabling the use of a packet data traffic channel and disabling the use of corresponding fundamental channel and supplemental channel; and disabling the use of the packet data traffic channel after transmission of the data packet.

Preferably, the packet data traffic channel is enabled only for a necessary duration for the transmission of the packet data.

Preferably, the packet data traffic channel is intermittently enabled to transmit intermittent packet data.

Preferably, in a packet data communication system between several terminals and a base station, the packet data traffic channel is intermittently used by each of a plurality of the terminals to intermittently transmit or receive packet data.

Preferably, a packet control channel transmits terminal identifier data to enable identified terminals to use the packet data traffic channel for a predetermined time slot.

Preferably, a base station performs the steps of outputting signalling signals from a packet controller to a packet control data transceiver for transmitting information on a requested communication to a packet controller of the terminal; outputting control signals to data transceivers, each connected to a traffic channel for enabling communication along at least one of the traffic channels; and transmitting or receiving data along the enabled traffic channel(s).

Preferably, one or more traffic channels are enabled according to the signalling signals; any other traffic channels are disabled; and data are received or transmitted along the enabled traffic channel(s).

Preferably, in transmitting packet data from the base station to the terminal, a control signal is sent from the base station packet controller to the terminal packet

controller on a packet control channel; a packet traffic data transceiver at the base station is set into a transmit mode; a packet traffic data transceiver at the terminal is set into a receive mode; a packet data traffic channel is connected; packet data is transmitted from the base station to the terminal; and, upon completion of the packet data reception, the packet data traffic channel is disconnected from the terminal.

Preferably, in transmitting packet data from the terminal to the base station, a control signal is sent from the base station packet controller to the terminal packet controller on a packet control channel; a packet traffic data transceiver at the terminal is set into a transmit mode; a packet data control channel is enabled; packet data is transmitted from the base station to the terminal; and, upon completion of the packet data transmission, the packet data traffic channel is disconnected at the terminal.

Preferably, a plurality of terminals intermittently receive or transmit packet data from or to the base station, over the packet data traffic channel, each terminal being connected to the packet data traffic channel for the duration of a packet data reception, before disconnecting from the packet data traffic channel, to enable use of the packet data traffic channel by another of the terminals.

The present invention also provides a base station for use in a communications system for transmission and reception of packet data, comprising a base station and a number of terminals. Preferably, the base station comprises a packet controller for controlling the transmission and reception of packet data. Preferably, the base station comprises a packet control data

transceiver for transmitting information on a communication type over a packet control channel. Preferably, the base station comprises a packet traffic data transceiver for transmitting and receiving packet data over a packet data traffic channel. Preferably, the base station comprises a fundamental data transceiver for transmitting and receiving data over a fundamental channel. Preferably, the base station comprises a supplementary data transceiver for transmitting and receiving data over a supplementary channel. The transceivers are preferably controlled by the packet controller.

The present invention also provides a terminal for use in a communications system for transmission and reception of packet data comprising a base station and a number of terminals. Preferably, the terminal comprises a packet controller for controlling the transmission and reception of packet data. Preferably, the terminal comprises a packet traffic data transceiver for transmitting and receiving packet data over a packet data traffic channel. Preferably, the terminal comprises a fundamental data transceiver for transmitting and receiving data over a fundamental channel. Preferably, the terminal comprises a supplementary data transceiver for transmitting and receiving data over a supplementary channel. Preferably, the terminal comprises first, second and third switches for connecting or disconnecting the packet data transceiver, fundamental channel transceiver and supplemental data transceiver to/from corresponding forward and reverse channels.

The present invention also provides a set of signals for use in a communication system for transmission and reception of packet data, including a packet control channel signal for transmitting control information

regarding the use of a packet data channel and one or more traffic channels; a packet data traffic channel signal for transmitting and/or receiving packet data; and one or more traffic channel signals for transmitting and/or receiving data.

The present invention also provides a communications system comprising a base station and a terminal.

Preferably, the one-to-one connection between a terminal and a base station should last only as long as packet data are exchanged and is released during a packet data communication suspension period, so that the capacity of communication channels is efficiently used and thus communication cost is saved for users.

Preferably, the packet data traffic channel is enabled only for the necessary duration for the transmission of the packet data.

Preferably, the present invention provides a packet data service providing method in a CDMA mobile communication system, for reducing the idle time of occupied data channels during intermittent packet transmission/reception while a call is established.

Preferably, the present invention provides a packet data service providing method, for processing voice and data channels independently.

Brief Description of the Drawings

The above described aims and advantages of the present invention, in addition to others, will become more apparent in the following detailed description of certain embodiments, given by way of examples only, with reference to the accompanying drawings in which:

FIG.1 is a block diagram of a terminal, a base station, and a radio link in a conventional mobile communication system;

FIG.2 illustrates the structure of a reverse channel in a conventional packet data service;

FIG.3 illustrates the structure of a forward channel in the conventional packet data service;

FIG.4 is a flowchart showing the operation of allocation of channels in the conventional packet data service;

FIG.5 illustrates a state transition diagram of a terminal on the basis of a conventional CDMA standard;

FIG.6 illustrates the structure of a forward channel in a packet data service according to an embodiment of the present invention;

FIG.7 illustrates the structure of a reverse channel in the packet data service of the embodiment of the present invention;

FIG.8 is a state transition diagram of a terminal for the packet data service of the embodiment of the present invention;

FIG.9 illustrates the timing of a packet control channel with respect to that of a forward packet traffic channel;

FIG.10 illustrates the timing of the packet control channel with respect to that of a reverse packet traffic channel; and

FIG.11 is a block diagram of a base station and a terminal in a communication system for the packet data service according to the embodiment of the present invention.

Detailed Description of the Drawings

A packet data service providing method in a CDMA communication system according to an embodiment of the present invention avoids unnecessary occupation of forward and reverse channels during a packet data service suspension period with a call established. Overheads caused by continuous occupation of fundamental channels for transmission/reception of packet data are thereby reduced. A packet data service to a large number of terminals with one or a small number of common channels is enabled.

New channel structures are designed for the packet data service of the present invention, as shown in FIGs. 6 and 7. A forward channel includes a pilot channel, a sync channel, a paging channel, and a forward traffic channel in FIG. 6. The forward traffic channel is divided into a fundamental channel and a supplemental channel. According to an aspect of the present invention, the forward channel also includes a packet control channel and a forward packet traffic channel.

A reverse channel includes an access channel, and a reverse traffic channel in FIG. 7. The reverse traffic channel is also divided into a fundamental channel and a supplemental channel. According to an aspect of the present invention, the reverse channel also includes a reverse packet traffic channel.

Two forward channels and one reverse channel are newly defined in the channel structures of FIGs. 6 and 7 for the packet data service according to the present invention: the packet control channel and the forward packet traffic channel in the forward channel; and the reverse packet traffic channel in the reverse channel.

The forward packet traffic channel supports a path of packet data travelling on a forward link from a base station to a terminal. The reverse packet traffic channel supports a path of packet data travelling on a reverse link from the terminal to the base station.

The packet control channel acts to control terminals so that packet data communication with a large number of terminals may be accommodated in a small number of forward and reverse packet traffic channels. It also controls the output power level of a terminal accessing a system on the reverse packet traffic channel, thereby controlling system capacity, in turn.

FIG. 8 is a state transition diagram of a terminal for the packet data service according to the embodiment of the present invention, using the new channels for the packet data service.

Referring to FIG. 8, when power is initially turned on, in a state 811, the terminal is set to an initialisation state 812. If the terminal synchronises its timing to that of a system in the initialisation state 812, it transits to an idle state 813. If the terminal attempts a call, the base station transmits information of the call attempt to the terminal on the paging channel, and the terminal sends a page response message to the base station on the access channel, in the idle state 813. Then, the terminal is set to a system access state 814. If the terminal fails to obtain a paging channel message or is directed from the base station to a different adjacent base station in a handoff in the idle state 813, the terminal returns to the initialisation state 812.

If the terminal succeeds in the call attempt or reception of the call acknowledge signal in the system access state

814, it goes to a traffic channel state 815. On the contrary, if the terminal succeeds in system access except for the call attempt or reception of a call acknowledge signal in the system access state 814, the terminal returns to the idle state 813. If a packet mode request is registered in the system access state 814, the terminal is set to a packet idle state 816. Meanwhile, when traffic channels stop their action in the traffic channel state 815, the terminal returns to initialisation state 812.

During transmission/reception of packet data, the terminal is directed from the packet idle state 816 to a packet busy state 817. Upon completion of each intermittent packet transmission/reception, the terminal returns to the packet idle state 816. The terminal alternates between the packet idle state 816 and the packet busy state 817 depending on packet data transmission/reception or vice versa. Using the example given above, the terminal may repeatedly spend one second in the packet busy state 817 followed by 59 seconds in the packet idle state 816. When the packet mode transmission/reception is over in the packet idle state 816, the terminal returns to the initialisation state 812.

The terminal mainly aiming at a packet data service as shown in FIG. 8 transits not to the traffic channel state 815 but to the packet idle state 816 upon registration of the packet mode in the system access state 814.

In the packet idle state 816, the terminal periodically monitors the packet control channel to determine whether there is packet data to be received on a forward packet traffic channel. In the presence of receive packet data, the terminal demodulates the forward packet traffic

channel during a predetermined time in the packet busy state 817.

When there is a packet data to be transmitted from the terminal in the packet idle state 816, the terminal waits for an authorisation to use a reverse packet traffic channel, while monitoring the packet control channel. Upon receipt of the authorisation, the terminal transmits the packet data on the reverse packet traffic channel in the packet busy state 817.

Upon completion of the packet data transmission/reception on the forward and reverse packet traffic channels in the packet busy state 817, the terminal returns to periodically monitoring the packet control channel in the packet idle state 816.

If a voice communication is required, the packet idle state 816 in which a packet traffic is interrupted (suspended) is transited to the traffic channel state 815. If a packet data service request is generated through the packet control channel in the state 815, the state is transited to the packet idle state 816. Then, in the state 816, a packet traffic channel is allocated and the state is transited to the packet busy state 817 so that a packet data service is provided.

The purpose of using the packet control channel is to reliably provide a packet data service to a large number of terminals each spending the majority of their time in the packet idle state, via a small number of forward and reverse packet traffic channels. The packet control channel also controls the output power level of a terminal on a reverse packet traffic channel, thus increasing system capacity.

Data transmitted on the packet control channel is

constituted as shown in table 1.

Table 1

forward packet traffic channel status	reverse packet traffic channel access control	reverse packet traffic channel power control bit (variable Band Width)	reserved

The packet control channel data of the above structure is repeatedly transmitted, and a single packet control channel occupies one code channel. A plurality of packet control channels can be used for many packet data service subscribers. Each single packet control is accompanied by one or more forward and reverse packet traffic channels.

As shown in table 1, the packet control channel should notify a terminal which forward traffic channel to occupy by broadcasting the status of the forward packet traffic channel. It also should broadcast information of access authority to terminals which intend to occupy a reverse packet traffic channel so that only an authorised terminal may transmit packet data on the reverse packet traffic channel. The packet control channels transmit power control bits to control the output power levels of terminals in the process of transmitting packet data on the reverse packet traffic channels. Then, the corresponding terminals should adjust their own output power levels as directed by the power control bit.

FIG.9 illustrates the timing of data on the packet control channel (FPC) with respect to that of the forward packet traffic channel (FPT), and FIG.10 illustrates the timing of the packet control channel (FPC) with respect to that of the reverse packet traffic channel (RPT).

Referring to FIG.9, reference numerals 9a and 9b denote the packet control channel and the forward packet traffic channel, respectively. Reference characters FPCi and FPTi indicate packet control channel data and forward packet traffic channel data, assigned to an i-th time slot, respectively.

The terminal is informed of the presence of packet data addressed thereto on the packet control channel 9a, and then demodulates the forward packet traffic channel 9b. The forward packet traffic channel status information FPCi of the packet control channel 9a assigned to an i-th time slot indicates a destination terminal for the packet data of the following, (i+1)-th, time slot of the forward packet traffic channel 9b. Here, a time slot unit $T=T_{i+1}-T_i$.

Referring to FIG.10, reference characters 10a and 10b denote the packet control channel and the reverse packet traffic channel, respectively. Reference character FPCi indicates packet control channel data assigned to an i-th time slot, for designating a terminal authorised to access an (i+1)-th time slot and controlling the power of terminals accessing in the i-th time slot. Reference character RPTi indicates reverse packet traffic channel data assigned to the i-th time slot and having a structure of preamble data. Only terminals authorised to access in an (i-1)-th time slot can access the i-th time slot and a terminal authorised but having no transmit data is denied access. Here, the time slot unit $T=T_{i+1}-T_i$.

FIG.11 is a block diagram of a base station and terminal for packet data communications in a communication system according to an embodiment of the present invention.

The control signals shown in FIG.11 are defined in the following table:

Table 2

F_SIGP	forward packet signal	R_CTL r_ctl	data receive control signal
R_SIGP	reverse packet signal	T_CTL t_ctl	data transmit control signal
F_SIGV	forward voice signal	F_ON	forward link ON reverse link OFF
R_SIGV	reverse voice signal	F_OFF	forward link OFF reverse link ON
F_SIGC	forward continuous data signal	OFF	forward link OFF reverse link OFF
R_SIGC	reverse continuous data signal		

In a base station 1100, a packet controller 1111 outputs corresponding signalling signals F_SIGP, F_SIGV, F_SIGC, R_SIGP, R_SIGV, R_SIGC to a packet control data transceiver 1113 and control signals R_CTL1, T_CTL1; R_CTL2, T_CTL2; R_CTL3, T_CTL3 to corresponding packet data transceiver 1115, fundamental data 1117 transceiver, and supplemental data transceiver 1119, in order to transmit packet data to a terminal 1200 or receive packet data from the terminal 1200.

The signalling signals output from the packet controller 1111 include a forward packet signal F_SIGP, a reverse packet signal R_SIGP, a forward voice signal F_SIGV, a reverse voice signal R_SIGV, a forward continuous data signal F_SIGC, and a reverse continuous data signal R_SIGC, and the control signals include data receive control signals R_CTL and data transmit control signals T_CTL.

The packet control data transceiver 1113 transmits the signalling signals F_SIGP, R_SIGP, F_SIGV, R_SIGV, F_SIGC, and R_SIGC on a packet control channel signal

under the control of the packet controller 1111. The packet traffic data transceiver 1115 transmits/receives packet data to/from the terminal 1200 on packet traffic channels according to control signals T_CTL1 and R_CTL1 output from the packet controller 1111. The fundamental data transceiver 1117 transmits/receives data to/from the terminal 1200 on fundamental channels according to control signals T_CTL2 and R_CTL2 output from the packet controller 1111. The supplemental data transceiver 1119 transmits/receives supplemental data to/from the terminal 1200 on supplemental channel according to control signals T_CTL3 and R_CTL3 output from the packet controller 1111.

In the terminal 1200, a packet controller 1222 outputs control signals r_ctl and t_ctl for receiving packet data on a forward channel or transmitting data on a reverse channel according to its analysis of the signalling signals received from the packet control data transceiver 1113 of the base station 1100. The packet controller 1222 also outputs switch control signals F_ON, F_OFF, and OFF for selecting forward or reverse links. Receive control signals r_ctl and transmit control signals t_ctl are used to control corresponding transceivers 1224, 1226 and 1228 for processing data transmitted/received on the forward/reverse channels. Each switch control signal F_ON serves to turn on a forward link and turn off a reverse link; each switch control signal F_OFF serves to turn off the forward link and turn on the reverse link, and each control signal OFF serves to turn off both the forward and reverse links.

First switch 1234 selects a path for the packet traffic data by the switch control signals F_ON1, F_OFF1, and OFF1 output from the packet controller 1222.

The packet traffic data transceiver 1224, connected to

the first switch 1234, transmits or receives packet data on a link selected by the switch 1234, under the control of the control signal t_ctl1 or r_ctl1 output from the packet controller 1222.

Second switch 1236 selects a path for the fundamental channel data according to the switch control signals F_ON2, F_OFF2, and OFF2 output from the packet controller 1222. The fundamental data transceiver 1226, connected to the second switch 1236, transmits or receives the fundamental channel data on a link selected by the second switch 1236 under the control of the control signal t_ctl2 or r_ctl2 output from the packet controller 1222.

Third switch 1238 selects a path for the supplemental channel data according to the switch control signals F_ON3, F_OFF3, and OFF3 output from the packet controller 1222. The supplemental data transceiver 1228, connected to the third switch 1238, transmits or receives the supplemental channel data on a link selected by the third switch 1238 under the control of the control signals t_ctl3 or r_ctl3 output from the packet controller 1222.

The base station 1100 and the terminal 1200 according to the present invention employ their respective channel structures for independently supporting packet data communications, as described before. That is, the channel structure of the present invention shown in FIGs. 6 and 7 newly define two forward channels and one reverse channel. Here, the new forward channels are a packet control channel and a forward packet traffic channel, and the new reverse channel is a reverse packet traffic channel. The forward packet traffic channel supports a path for packet data to be transmitted on a forward channel from a base station to a terminal. The reverse packet traffic channel supports a path for transmitting

packet data on a reverse channel from the terminal to the base station. In addition, the packet control channel allows a large number of terminals to share a small number of forward and reverse channels, and controls the output power levels of terminals accessing to a system via reverse packet traffic channels to thereby control system capacity.

There now follows a detailed discussion of various possible communication modes.

Intermittent forward packet data communication from the base station 1100 to the terminal 1200

The packet controller 1111 sends the control signal F_SIGP to the packet controller 1222 on the packet control channel by controlling the packet control data transceiver 1113, and outputs the control signal T_CTL1 to the packet traffic data transceiver 1115 to designate a forward packet traffic channel. Upon receipt of the control signal F_SIGP from the base station 1100, the packet controller 1222 outputs the control signal r_ctl1 to the packet traffic data transceiver 1224, and the control signals F_ON1, OFF2, OFF3 to the first to third switches 1234 to 1238, respectively. In this case, the base station 1100 sends packet data on the designated forward packet traffic channel and the terminal 1200 processes the packet data received via the designated forward packet traffic channel. During transmission/reception of packet data on the forward link, the base station 1100 and the terminal 1200 use only the packet traffic channels, not forward fundamental and supplemental channels. Upon completion of the packet data transmission/reception on the forward link, the packet controller 1222 outputs the control signal OFF1 to the first switch 1234 to disconnect the packet data

transmission/reception path on a forward link.

Intermittent reverse packet data communication from the terminal 1200 to the base station 1100

The packet controller 1111 of the base station 1100 outputs the control signal R_SIGP to the packet controller 1222 of the terminal 1200 on the packet control channel by periodically controlling the packet control data transceiver 1113. In the presence of packet data to be transmitted to the base station 1100, the packet controller 1222 of the terminal 1200 designates a packet traffic channel by outputting the control signal t_ctl1 to the packet traffic data transceiver 1224 and selects a reverse packet traffic channel by outputting the control signal F_OFF1 to the first switch 1234. The packet controller 1222 of the terminal 1200 turns off a link for a fundamental channel and a supplemental channel by outputting the control signals OFF2 and OFF3 to the second and third switches 1236 and 1238, respectively. Then, the terminal 1200 transmits packet data on the reverse traffic channel to the base station 1100. On the other hand, in the absence of packet data to be transmitted to the base station 1100, the packet controller 1222 of the terminal 1200 outputs the control signals OFF1, OFF2 and OFF3 to the first to third switches 1234, 1236, and 1238 respectively, to thereby turn off the link for the channels.

Continuous forward data communication from the base station 1100 to the terminal 1200

The packet controller 1111 of the base station 1100 sends the control signal F_SIGC to the packet controller 1222 of the terminal on the packet control channel by controlling the packet control data transceiver 1113, and

outputs the control signals T_CTL2 and T_CTL3 to the fundamental data transceiver 1117 and the supplemental data transceiver 1119, respectively, to thereby send data on fundamental and supplemental channels. Upon receipt of the control signal F_SIGC, the packet controller 1222 of the terminal 1200 outputs the control signals r_ctl2 and r_ctl3 to the fundamental data transceiver 1226 and the supplemental data transceiver 1228, respectively, and outputs the control signals F_ON2 and F_ON3 to the second and third switches 1236 and 1238, respectively, so that a path is designated to receive data continuously on the forward fundamental and supplemental channels. Then, the base station 1100 continuously transmits data on the designated forward fundamental and supplemental channels to the terminal 1200.

Continuous reverse data communication from the terminal 1200 to the base station 1100

The packet controller 1111 controls the packet control data transceiver 1113 to periodically transmit the control signal R_SIGC to the packet controller 1222 of the terminal 1200 on the packet control channel, and receives continuous data from the terminal 1200 on reverse fundamental and supplemental channels by outputting the control signals R_CTL2 and R_CTL3 to the fundamental data transceiver 1117 and the supplemental data transceiver 1119, respectively. In addition, in the presence of data to be continuously transmitted to the base station 1100, the packet controller 1222 of the terminal 1200 outputs the control signals t_ctl2 and t_ctl3 to the fundamental data transceiver 1226 and the supplemental data transceiver 1228, respectively, and the control signals OFF1, F_OFF2, and F_OFF3 to the first to third switches 1234 to 1238. Then, the terminal 1200 continuously outputs data on the reverse fundamental

supplemental channels. In the absence of data to be continuously transmitted to the base station 1100, the packet controller 1222 outputs the control signals OFF1 to OFF3 to the first to third switches 1234 to 1238, respectively. Therefore, the terminal 1200 transmits data continuously on the designated reverse fundamental and supplemental channels to the base station 1100.

Forward voice communication from the base station 1100 to the terminal 1200

The packet controller 1111 of the base station 1100 sends the control signal F_SIGV to the packet controller 1222 of the terminal 1200 by controlling the packet control data transceiver 1113 and outputs voice data on the forward fundamental channel by outputting the control signal T_CTL2 to the fundamental data transceiver 1117. Upon receipt of the control signal F_SIGV on the forward packet control channel, the packet controller 1222 of the terminal 1200 outputs the control signals r_ctl2 to the fundamental data transceiver 1226, and the control signals OFF1, F_ON2, and OFF3 to the first to third switches 1234 to 1238, respectively. Thus, the base station 1100 transmits the voice data on the forward fundamental channel to the terminal 1200.

Reverse voice communication from the terminal 1200 to the base station 1100

The packet controller 1111 of the base station sends the control signal R_SIGV to the packet controller 1222 of the terminal 1200 on the packet control channel by controlling the packet control data transceiver 1113 and designates a reverse fundamental channel by outputting the control signal R_CTL2 to the fundamental data transceiver 1117. Here, in the presence of voice data to

be transmitted to the base station 1100, the packet controller 1222 of the base station 1200 outputs the control signal t_ctl2 to the fundamental data transceiver 1226 and designates the reverse fundamental channel by outputting the control signals OFF1, F_OFF2, and OFF3 to the first to third switches 1234 to 1238, respectively. Thus, the terminal 1200 outputs voice data on the reverse fundamental channel to the base station 1200.

As described above, the present invention may maximise channel resource use efficiency in a packet data service of a mobile communication network by introducing the packet control channel and the forward and reverse packet traffic channels. That is, the forward or reverse channels are occupied during packet data transmission/reception after a call set-up, and are unoccupied during packet data transmission/reception suspended periods between intermittent packet data transmission/reception, thereby enabling efficient use of channel capacity.

While the present invention has been described in detail with reference to one specific embodiment, it is to be clearly understood that many variations can be made within the scope of the present invention. For example, in implementing the packet data service as described above, the timing of the packet control channel with respect to that of the packet traffic channel can be different from that as shown in FIGS. 9 and 10. For example, the i-th time slot of the packet control channel may designate an (i+j)-th time slot of the packet traffic channel instead of the (i+1)-th time slot.

CLAIMS:

1. A method for providing a packet data communication service between a terminal and a base station in a mobile communication system, comprising the steps of:

- occupying a reverse channel during a data transmission period;

- transmitting packet data from the terminal to the base station on the occupied reverse channel during the data transmission period; and

- releasing the occupation of the reverse channel during a data transmission suspended period.

2. A method for providing a packet data communication service between a terminal and a base station in a mobile communication system, or a method according to claim 1, comprising the steps of:

- occupying a forward channel during a data transmission period;

- transmitting packet data from the base station to the terminal on the forward channel during a data transmission period; and

- releasing the occupation of the forward channel during a data transmission suspended period.

3. A terminal comprising:

- means for occupying a reverse channel during a data transmission period;

- means for transmitting packet data from the terminal to the base station on the occupied reverse channel during the data transmission period; and

- means for releasing the occupation of the reverse channel during a data transmission suspended period.

4. A base station comprising:

- means for occupying a forward channel during a data transmission period;

- means for transmitting packet data from the base station to the terminal on the forward channel during a data transmission period; and

- means for releasing the occupation of the forward channel during a data transmission suspended period.

5. A method, terminal or base station according to any preceding claim wherein control signals are transmitted over a packet control channel from the base station to the terminal to control occupancy of forward and reverse channels.

6. A method, terminal or base station according to any preceding claim wherein one or both of the forward and reverse channels each comprise a traffic channel and a packet data traffic channel.

7. A method, terminal or base station according to claim 6 wherein the traffic channel comprises a fundamental channel and a supplemental channel.

8. A method, terminal or base station according to any preceding claim, wherein providing a packet data communication service includes the steps of:

- transmitting a control signal over a packet control channel to indicate that packet data is to be transmitted;

- enabling the use of a packet data traffic channel and disabling the use of a corresponding traffic channel; and

- disabling the use of the packet data traffic channel after transmission of the data packet.

9. A method, terminal or base station according to claim 8 wherein the packet data traffic channel is enabled for a duration for the transmission of the packet data.

10. A method, terminal or base station according to claim 9 wherein the packet data traffic channel is intermittently enabled to transmit intermittent packet data.

11. A method, terminal or base station according to claim 10 for providing a packet data communication system between several terminals and a base station, wherein the packet data traffic channel is intermittently used by each of a plurality of the terminals to intermittently transmit or receive packet data.

12. A method, terminal or base station according to claim 11 wherein a packet control channel transmits terminal identifier data to enable identified terminals to use the packet data traffic channel for a predetermined time slot.

13. A method or base station according to any preceding claim including, within a base station, the steps of:

- outputting signalling signals from a packet controller to a packet control data transceiver for transmitting information on a requested communication to a packet controller of the terminal;

- outputting control signals to one or more data transceivers, each connected to a traffic channel for enabling communication along at least one traffic channel; and

- transmitting or receiving data along the enabled traffic channel(s).

14. A method according to claim 13 or a terminal according to any preceding claim including, within a terminal, the steps of:

- enabling one or more traffic channels according to the signalling signals

- disabling any other traffic channels; and

- receiving or transmitting data along the enabled traffic channels.

15. A method, terminal or base station according to claim 13 or claim 14 for transmitting packet data from the base station to the terminal, comprising the steps of:

- sending a control signal from the base station packet controller to the terminal packet controller on a packet control channel;

- setting a packet traffic data transceiver at the base station into a transmit mode;

- setting a packet traffic data transceiver at the terminal into a receive mode;

- connecting to a packet data traffic channel;

- transmitting packet data from the base station to the terminal; and,

upon completion of the packet data reception, disconnecting the packet data traffic channel at the terminal.

16. A method, terminal or base station according to claim 13 or claim 14 for transmitting packet data from the terminal to the base station, comprising the steps of:

- sending a control signal from the base station packet controller to the terminal packet controller on a packet control channel;

- setting a packet traffic data transceiver at the terminal into a transmit mode;

- enabling a packet data control channel;

- transmitting packet data from the base station to the terminal; and,

upon completion of the packet data transmission, disconnecting the packet data traffic channel at the terminal.

17. A method, terminal or base station according to claim 15 wherein a plurality of terminals intermittently receive or transmit packet data from or to the base station, over the packet data traffic channel, each

terminal being connected to the packet data traffic channel for the duration of a packet data reception, before disconnecting from the packet data traffic channel, to enable use of the packet data traffic channel by another of the terminals.

18. A base station for use in a communications system for transmission and reception of packet data, comprising a base station and a number of terminals, the base station comprising:

- a packet controller for controlling the transmission and reception of packet data;

- a packet control data transceiver for transmitting information over a packet control channel;

- a packet traffic data transceiver for transmitting and receiving packet data over a packet data traffic channel;

- a fundamental data transceiver for transmitting and receiving data over a fundamental channel; and

- a supplementary data transceiver for transmitting and receiving data over a supplementary channel,

wherein the transceivers are controlled by the packet controller.

19. A terminal for use in a communications system for transmission and reception of packet data, comprising a base station and a number of terminals, the terminal comprising:

- a packet controller for controlling the transmission and reception of packet data;

- a packet traffic data transceiver for transmitting and receiving packet data over a packet data traffic channel;

- a fundamental data transceiver for transmitting and receiving data over a fundamental channel;

- a supplementary data transceiver for transmitting and receiving data over a supplementary channel; and

- first, second and third switches for connecting or disconnecting the packet data transceiver, fundamental channel transceiver and supplemental data transceiver to/from corresponding forward and reverse channels.

20. A set of signals for use in a communication system for transmission and reception of packet data, including:

- a packet control channel signal for transmitting control information regarding the use of a packet data channel, and one or more traffic channels;

- a packet data traffic channel signal for transmitting and/or receiving packet data; and

- one or more traffic channel signals for transmitting and/or receiving data.

21. A communications system comprising a base station according to any preceding claim and a terminal according to any preceding claim.

22. A method for providing a packet data communication substantially as described, with reference to and/or as illustrated in figures 6-11 of the accompanying drawings.

23. A terminal substantially as described, with reference to and/or as illustrated in figures 6-11 of the accompanying drawings.

24. A base station substantially as described, with reference to and/or as illustrated in figures 6-11 of the accompanying drawings.

25. A set of signals substantially as described, with reference to and/or as illustrated in figures 6-11 of the accompanying drawings.

The Patent Office

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Application No: GB 9815204.4 **Examiner:** Nigel Hall
Claims searched: 1-17 **Date of search:** 3 December 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H4L (LDGP)

Int Cl (Ed.6): H04Q 7/22

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	WO 97/48249 A1 (NOKIA) See p1 line 30- page 2 line 1	
X	WO 97/20444 A1 (AT&T) See whole document	
X	EP 0615393 A1 (MOTOROLA) See whole document	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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